

Technical Education

A Portrait of Current Practice in Scottish Schools

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1. Introduction

Technical Education – a portrait of current practice is one in a series of portraits by HMIE, illustrating current practice in key aspects of the Scottish curriculum. The portrait series is a recent initiative by HMIE, flowing from the *Improving Scottish Education* (ISE) report¹. It is intended to promote improvements in Scottish education by drawing on the findings of inspections, to stimulate reflection and debate and to promote improvements. This portrait draws on inspections from 2002 – 2007 and from examples of effective practice in schools which were showcased at HMIE good practice conferences in 2006 and 2007. These presentations exemplified high standards in young people's experience, from pre-school to higher education, across the spectrum of technical education, and with a special focus on meeting pupils' needs. The portrait will be updated and enhanced with further case studies and inspection evidence in due course.

An important purpose of this portrait is to relate current thinking and practice on learning and teaching, and the curriculum of technical education, to the aspirations of *Curriculum for Excellence*². It aims to stimulate all of us with an interest in learning and teaching in technical education to engage in considering how well our subject promotes the development of the four capacities for all young learners, and thereby make a contribution towards a smarter Scotland.

2. Improving Scottish Education

Improving Scottish Education (ISE) was published by HMIE in March 2006. It highlighted the importance of building on the strengths in Scottish education to help learners in the twenty first century prepare for the challenges of a changing global society. Particular themes in the ISE report which strike a chord with the priorities being considered by practitioners in technical education include:

- achievement; and
- curriculum, learning and teaching.

The range of subjects which comprise technical education has changed significantly over the last two decades. This has challenged teachers to update their knowledge and skills regularly. Through the determination of teachers and schools to implement these changes well, we now have a clear understanding of how applications of information and communications technology (ICT) promote effective learning in craft, design, engineering and graphics. It is important for us now to achieve a similar understanding of what constitutes good learning and teaching in technical education. The HMIE resources associated with *Journey to Excellence*², which include self-evaluation guidance and exemplification of effective practice, will be of particular help in doing so. (www.journeytoexcellence.org.uk)

2.1. Achievement

Effective learning and teaching in technical education promotes high achievement among young people and raises their attainment across a wide range of experiences. Successful teaching helps pupils to achieve commendably high standards of craftsmanship, in product design, engineering technology and graphics. Pupils learn to solve technological problems of

¹ Improving Scottish Education. HM Inspectors of Education 2006

² *Curriculum for Excellence* - the four *capacities* : Successful Learners; Confident Individuals; Responsible Citizens; and Effective Contributors

increasing complexity, applying design processes creatively and using a wide range of ICT to promote learning. These appropriately high expectations now form the benchmark for effective technical education at a time when it can contribute even more fully in the developing curriculum.

A close relationship exists between the subjects of technical education, the creative and manufacturing industries and Scotland's skills strategy. That relationship brings with it special opportunities to relate technical education to key economic, social and environmental priorities. However, the relationship also presents particular challenges, and places responsibilities on those who provide technical education to innovate to keep pace with the changing industrial world and major social issues including sustainability. One such challenge is to ensure that the best aspects of the current Standard Grade and National Qualification courses in technical education are used as a basis for further improvement. For example, we need to consider how to ensure a more appropriate position in the curriculum for engineering technology, in keeping with its importance educationally, socially and economically. Whilst we have made progress in offering technical education programmes which address gender issues and appeal to pupils from across the ability spectrum, more still needs to be done in both these respects. Another aspect which requires continuing thought is the need for the technical subjects to take full recognition of learners as individuals, and to provide experiences which promote unique, personal responses.

2.2. Curriculum, learning and teaching

In many schools the curriculum in technical education has major strengths. Effective programmes link primary and secondary activities well and build learning progressively to maximise achievement. These programmes engage the full range of pupils, including those at risk of missing out or of becoming disaffected, particularly through vocational education and education for work and enterprise. Balanced programmes bring a range of experiences in craft, engineering and graphics together in a coherent way, often providing a comprehensive experience from S1 onwards. The practical emphasis and direct vocational relevance in technical education appeals to learners who prefer more practical, skills-based approaches to learning. It is vital that we continue to meet pupils' needs, and indeed meet them better in those schools where provision is less strong. It is important for all of us with an interest in technical education to reflect on emerging strategies and programmes, such as the national *Skills for Scotland* strategy and Skills for Work courses. Reference to these major influences will help locate and guide technical education within the developing school curriculum, and relate its contribution more effectively to post-school provision. Effective teaching develops learners' analytical problem-solving skills, and their expertise in applying design processes, creative strategies and computer applications in craft, graphics and engineering. Technical education brings together "hands-on" with "minds-on", and taps pupils' natural instinct and desire to create, as a motivation for developing skills, knowledge, understanding and attitudes. Good practice in teaching challenges all learners and gives appropriate support for those experiencing difficulties.

3. How can technical education help to develop successful learners, confident individuals, responsible citizens, and effective contributors?

Teachers of technical education are responding well to the principles of *Curriculum for Excellence* and the opportunities it presents to improve pupils' attainment and wider achievement. This section of the portrait explores some of the more specific contributions which technical education makes to promoting learners' personal achievements. It also includes links to illustrations of good practice.

What do we do well presently in technical education to develop successful learners?

Signpost to successful learners

Successful learners often display the following characteristics.

- *They develop progressively their abilities as designers and engineers, applying an increasingly wide range of knowledge, understanding and practical and intellectual skills.*
- *They show a growing awareness of the technologies which form part of their daily lives, including the materials and production processes created and shaped by humans.*
- *They work effectively individually and in teams, to observe, define and predict technological problems, and identify alternative solutions to address these problems.*
- *They show creativity in applying design principles and using the spectrum of ICT applications.*

Well-structured programmes, appropriate means of providing helpful feedback, recognising and celebrating achievements in technical education, all contribute to the development of successful learners. Learners respond with enjoyment to the challenge and relevance which they find in high quality programmes. Some key features are as follows.

- Information about pupils' previous experience and achievements, for example in primary school, is used to inform the planning of learning activities.
- Early contacts with pupils as they enter secondary school, such as P7-S1 transition and induction programmes, are used skilfully to promote a positive image of the subject and to capture pupils' interest from the outset of their secondary school experience.
- Time is used efficiently and learning paced briskly at all stages, encouraging pupils to regard time as one of the most important resources to be managed in achieving success.
- Programmes offer an experience which is relevant to every individual pupil's interests and abilities, developing their capacities in the practical and intellectual contexts of technical education.
- Activities offer substantial choice and significant scope for personalisation of activities.
- Programme design includes deliberate strategies to meet the needs of all pupils, including the most able and those with learning difficulties or at risk of missing out.

- The curriculum exploits to the full the motivation which can arise from vocational relevance and the relationship which technical education has with enterprise, entrepreneurship and the creative and manufacturing industries.
- Learning and teaching approaches build on the enjoyment which most pupils find in designing and making, emphasising real-life contexts and products and using ICT fully.
- Learners show increasing ability to tackle technological tasks which go beyond their current experience.

How might technical education contribute more to successful learning?

It is important to identify ways of building on the above strengths to develop successful learners. As we continue to improve our approaches, we could usefully consider the following questions.

- How well do we build on learners' experiences in primary schools as they progress through the subsequent stages?
- How well do we create a positive image of the subject for boys and girls and an active, up-beat sense of expectation?
- How do we find out what pupils' attitudes towards the technologies are and how they feel about the experiences we offer?
- How well do we develop learners' awareness of the technologies in their immediate environment, for example through introducing them to real technological problems to be solved in their school and community?
- Do we give enough attention to raising learners' understanding of how technologies affect them personally, in their community and globally, and how their experience of technical education relates to that wider perspective?
- How far have we progressed towards providing every pupil with an experience pitched to meet their individual needs and aspirations? Or, how much do we still offer single activities to a whole class, regardless of the different interests or abilities within it?

Confident Individuals

Signpost to confident individuals.

Confident individuals often display the following characteristics.

- *They show enjoyment and enthusiasm in their activities.*
- *They act responsibly and independently, achieving progress through tasks with a minimum of teacher intervention.*
- *They respond well to new challenges or questions about their tasks.*
- *They seek innovative solutions to new problems, which require them to go outwith their existing skills and knowledge.*

What do we presently do well in technical education to develop confident individuals?

Many teachers of technical education use approaches which enable learners to become increasingly confident. Some key features of these approaches include the following.

- Teachers use the opening and conclusion of lessons to show learners how they are progressing in attitudes, knowledge and understanding and skills in technical education, for example by summarising previous learning and by previewing next steps.
- Staff provide pupils with clear, helpful feedback, written where appropriate, sufficiently detailed and effectively focused to support them in taking steps to improve future work.
- Effective teachers and teams support pupils in understanding the skills they are developing in craft, graphics and engineering aspects of technology and of their progress in generating creative solutions, solving technological problems and applying design processes.
- Displays of pupils' work in many departments, more widely across the school and in special exhibitions and competitions, give recognition to their achievements, contributing to their growing confidence as technologists.
- Pupils gain confidence from the experience of working in teams, solving real technological problems and presenting their ideas and solutions to different audiences.
- Staff make full use of school-wide incentive and reward schemes to ensure that pupils' achievements and progress in technical education receive due recognition.
- Pupils are helped to recognise the links between their experience in technical education, enterprise and entrepreneurship and vocational routes, building their confidence in taking decisions about possible future careers.
- Departments make appropriate use of the vocational relevance of technical education to help create a sense of purpose, taking particular care to build on pupils' enjoyment of the subject.

How might technical education contribute more to developing confident individuals?

Good quality experiences in technical education make a significant contribution to developing learners' confidence. As we continue to improve our practice as teachers of technical education the following questions will remain important.

- How useful and substantial is the feedback which we give to learners on all aspects of their work in technical education? Does it actually help them make progressive improvements, through clearly identified steps to take?
- What role does homework currently play in increasing learners' confidence?
- Are tasks in technical education suitably pitched at learners' different stages of progress, and suitably differentiated and structured to extend their confidence?
- In our approaches to learning and teaching, do we recognise fully the important role played by the appropriate use of praise in raising pupils' confidence?

Responsible Citizens

Signpost to responsible citizens.

Responsible citizens often display the following characteristics.

- *They are aware of the impact which their actions and those of others have on the environment, locally and globally.*
- *They are aware of the importance of environmental management including the underpinning theories of reduce, re-use and recycle.*
- *They seek proactively to find ways of addressing needs in their own community and more widely.*
- *They appreciate the importance of being well informed about technologies and technical education, with knowledge, understanding and skills which help them exercise judgement as consumers.*
- *They recognise the importance of sustainability as a key factor in design and technology.*

What do we presently do well in technical education to develop responsible citizens?

Technical education can make an important contribution to developing young people as responsible citizens. Experience of the technical subjects can demonstrate to individuals how they can apply their practical and problem solving skills for the benefit of the school and wider community. In particular, technical education can equip learners with the skills they need to become informed consumers. They can learn how to select the goods and services they need, and also how to deal with any difficulties they encounter as consumers. Some of the key characteristics of technical education which are presently developing responsible citizens include the following.

- Effective departments give a strong emphasis to developing pupils' attitudes and capabilities regarding environmental issues, including those associated with the depletion of finite resources, the negative effects of different technologies on the environment, and the potential for technical education to play a part in environmental improvements through sustainable design.
- Appropriate courses in the engineering aspects of technology support informed decision-making by helping individuals to recognise the quality of different products, such as cars and white goods.

- Programmes which include tasks located in pupils' immediate community and environment help them to take responsible action to meet defined community needs.

For further information about citizenship, you may wish to refer to HMIE's published portrait on Education for Citizenship. (www.hmie.gov.uk)

How might technical education contribute more to developing responsible citizens?

Technical education has the potential to make a more significant contribution to promote active, responsible citizenship. In particular, it could help learners develop a more balanced view of the social value and impact of technology. Technical subjects offer both technical skills and good contexts for teaching core skills such as numeracy, literacy, team working, problem solving and ICT. As we continue to improve our approaches, as teachers of technical education we could usefully consider the following questions.

- Do we provide enough opportunities for pupils, from the earliest stages, to work in groups towards a common goal?
- How much coverage do we give to important issues of the environment, consumer skills, or career options relevant to technical education?
- Do we make clear the relevance of technical education to issues of responsible citizenship, such as our use of scarce resources?
- Do we provide effective approaches to encourage a balanced view of the technologies and technical education, and counter any negative views pupils may have of science and technology?
- Do we encourage and exemplify good practice in researching information about technical and technological developments? In particular, do we equip our learners to exercise judgement in complex social, economic or environmental contexts?

Effective Contributors

Signpost to effective contributors

Effective contributors often display the following characteristics.

- *They listen carefully to problems being described, reflect on these and identify contributions which they and others might make to achieve a solution.*
- *They work well individually and collectively, clear about their role in an overall enterprise.*
- *They develop and demonstrate skills which have significant value for the community, to the economy and in terms of employability.*
- *They show creativity in tackling problems, and resilience in taking stock and attempting different approaches where a first solution proves less than effective.*

What do we presently do well in technical education to develop effective contributors?

A positive experience of technical education at school can help young people to make effective contributions at home, at work, in leisure and in the wider life of the community and society. The subject can contribute readily to learning in other areas of the curriculum, such as creative and aesthetic aspects, for example through interdisciplinary projects. These contributions can stem from the development of skills and knowledge which equip learners to bring about change in the different contexts in which they live and work. In some cases this may range from, for example, solving a storage problem in their bedrooms as a young

teenager, to designing an energy saving device as a professional engineer. Some of the key characteristics which are presently developing effective contributors include the following.

- Active, participative activities for all learners are at the core of the learning experience.
- Working with primary school staff to plan pupils' transition into S1, effective secondary departments ensure they provide stimulating early experiences. These experiences demonstrate clearly the usefulness of the skills learned in technical education, and their relevance to pupils' everyday lives, future interests and careers.
- Activities at all stages are designed to ensure that pupils' ideas and views are actively encouraged, valued and incorporated into chosen solutions to practical or graphical problems.
- Tasks from S1 or earlier demonstrate the value of teamwork to pupils, showing how different individual strengths can combine to solve a common problem.
- The technical skills developed at school are linked to contexts pupils recognise as important in their futures, such as when they become householders. Programmes also provide important transferable skills including manual dexterity, graphicacy, understanding of how technology systems work, and problem solving.
- Technical education teachers help pupils to see the career relevance of their learning, and the contribution they can make to successful businesses and the local and national economies.

How might technical education contribute more to developing effective contributors?

Technical education is making an increasingly important and recognised contribution to the development of effective contributors. Its potential as a positive influence on a broad range of careers, and on the contribution they can make as informed consumers and skilled producers, is increasingly recognised. As we continue to improve our approaches, as teachers of technical education we could usefully consider how we prepare pupils to contribute effectively by reflecting on the following questions.

- Does technical education emphasise sufficiently its relevance to economic well-being, as a major contributor towards pupils' potential employment and to the creative and manufacturing industries?
- Do we plan systematically to ensure that pupils appreciate the links between their studies in technical education, the world of work, opportunities for enterprise and entrepreneurship and specific careers, and the roles and contributions they can make in these contexts?
- Do we highlight the contribution technical education makes to individuals' understanding of major social and economic issues such as environmental pollution, sustainability, energy and resource conservation, concerns associated with local, national and global travel patterns and advances in medical technologies?
- How best can we achieve an appropriate emphasis on ensuring that learners see how experience in technical education helps equip them as householders, for leisure activities and as informed consumers, in all of which contexts they can play an active part?

- Do we ensure that pupils develop a positive view of the capacity of technical education as a key influence on advances in the quality of citizens' life?

4. Conclusion

Technical education is playing an increasingly important role in the lives and educational experiences of many young people. Scotland has a long tradition of inventiveness, technological innovation and excellence in engineering and craftsmanship. This provides an important sense of identity for contemporary technical education, on which the subject needs to build confidently to meet society's future needs. To face the challenges of global competition, technical education shares with other areas of the curriculum the important responsibility to develop young learners with ambition, creativity and the determination to succeed.

The key attributes and achievements of technical education are exemplified in schools across the country, some of which were represented in the showcases at HMIE good practice conferences in 2006 and 2007. In particular, effective technical education helps learners to:

- understand and appreciate the technologies which influence their everyday lives;
- appreciate how they can use technical expertise to interact with these technologies, to bring about improvements in the quality of their own lives and those of others;
- develop informed attitudes towards technology and extend skills, knowledge and understanding in technical education; and
- see the relevance of their technical education experiences to their current lives, and into the future as householders, workers and citizens, in particular appreciating the relationship which technical education has with Scotland's skills strategy and enterprise, entrepreneurship, vocational preparation and the creative and manufacturing industries.

Many technical education staff teach very effectively to promote high achievement. In order to achieve greater consistency and continuous improvement in the quality of achievement, the following questions now need to be considered.

- How effective and productive is curricular liaison between secondary and primary schools? How well are the roots of technical education in the early years understood?
- Where does provision at S1/S2 show particular weaknesses in the context of the four capacities of *Curriculum for Excellence*?
- How best can the key qualities of the Standard Grade and National Qualification courses in technical education be used as a basis for further improvement?
- What can be done to promote learning in the engineering aspects of technology, to a position in keeping with their importance educationally, socially and economically?
- What can schools and education authorities do to ensure that the best of current practice in technical education becomes a consistent experience for pupils in all schools?
- What innovative approaches might be promoted to ensure access for all pupils to leading edge technologies such as those in ICT, relevant to technical education?

Appendix 1

Ambitious Excellent Technical Education showcases, relating to margin references

1. F1 in Schools Technology Challenge

Blairgowrie High School, Perth and Kinross Council

Blairgowrie High is a rural school with 1050 pupils, set 20 miles north east of Perth. The technical department has four full time staff and one probationer and offers all technical subjects at all levels.

The showcase took the form of a display, plus demonstrations of the CNC router cutting the F1 cars and other items. "Team Technic" and two teaching staff were on hand to answer any questions. F1 in Schools Technology Challenge is a national competition in which Blairgowrie HS has enjoyed much success since entering three years ago, reaching national finals every year and international finals in 2006 and 2007, coming second in the world in 2007 in Melbourne, Australia. The competition promotes enterprise through sponsorship, CAD/CAM and CAG skills, presentation skills both visual and formal, and is open to all years within secondary education in groups of S1/2, S3/4 and S5/6. The brief for the competition is to design, build and race a CO₂ powered F1 car to race along a 25 metre track.

2. Marker pen illustration and graphic layout & display

Kinross High School, Perth and Kinross Council

Kinross High School is a rural school with around 900 pupils. In the Design and Technology department the emphasis is on a creative approach to learning. This creative core drives learning through developing problem-solving skills and an ethos that encourages exploration. The staff operate an open-door policy that supports a teamwork approach.

The showcase focused on simple marker pen illustration techniques followed by the principles of graphic layout and display, leading to the following learning outcomes.

- Freehand sketching techniques
- Working in a creative environment
- Illustration procedures
- Rendering techniques
- Employing the techniques learned in other areas of the curriculum
- Using layout to achieve visual impact in a graphic display.

3. Card modelling of building; Modelling clay model of razor; Quick marker sketching of ideas

Royal High School, City of Edinburgh Council

The Royal High School is a City of Edinburgh comprehensive with 1100 pupils and around 110 staff. The school's roots can be traced back to 1128. It has recently been refurbished creating excellent new facilities. The CDT team comprises six staff. Almost 900 pupils take part in technical education courses every week, of whom around 460 are from S3 to S6.

The Royal High offered three mini showcases.

3.1 Card modelling of building

After a period on manual drafting of prisms, cones, cylinders and pyramids and more, pupils were given a brief to design using 2 point perspective, and make a building to scale, for a model railway layout. The building had to be relatively complex and folded up from a two dimensional surface development. Surface detail had to be realistic and of a high standard.

3.2 Modelling clay model of razor

This model is usually offered by the school right at the beginning of the Higher course to create pupil interest, recognising that some pupils are worried about their drawing ability. The task allows them an early opportunity for confidence building, by creating a product quickly in 3D using modelling clay.

3.3 Quick marker sketching of ideas; a disposable camera

This was based on a variety of mini projects to cover the required design knowledge. Most of these projects required a small folio of three to six pages. The focus was on laying down ideas in sketch form quickly so that the idea was not lost. Quick sketches using fibre tip pens were then enhanced with a little marker shadow to make them 3D and to add detail.

4. Timber framed buildings

Johnstone Technical Education Centre (JTEC), Johnstone

JTEC offers pre-vocational training and general education for young people intent on working in the construction industry, particularly as joiners. The training programme is aimed at young people who have previously had difficulties in school, due to behavioural and/or academic problems, where their education may have been disrupted by periods of exclusion and/or other factors.

The showcase demonstrated an experimental construction project where the pupils constructed a corner section of a timber framed building from wall plate level to ceiling. This included specific trade skills: joinery, AMES taping and glazing, including a demonstration of how a double glazed panel is assembled. The building progressed throughout the day from floor level to ceiling level, with the objective achieved that all fixtures and surfaces were ready for painting by the end of the conference.

5. Modelling in Craft and Design Standard Grade

St Andrew's and St Bride's High School, East Kilbride, South Lanarkshire Council

St Andrew's and St Bride's High School is a recently-merged school situated in East Kilbride, with a pupil roll of around 1800.

The showcase demonstrated modelling of a workstation from a given design brief. The brief concerns the redesign of an MSP's workstation, with an emphasis on the application of ergonomic and aesthetic knowledge.

Learning outcomes included the following.

- Communication of ideas through sketching and drawing
- Knowledge of aesthetics with relation to design
- Knowledge of ergonomics with relation to design
- Modelling techniques as a method of communicating ideas
- Understanding of construction methods.

6. ICT in a CDT context

Leith Academy, City of Edinburgh Council

Leith Academy is an inner city school situated in the north of Edinburgh, with a pupil roll of 1000 drawn from a wide ability range and large catchment area. The CDT Department has four staff and a full-time technician.

The showcase profiled two examples of using ICT in context.

- Pupils working on a Design Folio using ICT; "e-assessment" of this Folio
- Pupils demonstrating Graphic Communication in S3 (3D CAD using a library); e-assessment of this Folio